AD-A094 636 COLD REGIONS RESEARCH AND ENGINEERING LAB HANOVER NH F/G 8/10
COOLING TENDENCY IN THE SURFACE WATER OF THE NORTH ATLANTIC OCE--ETC(U)
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Draft Translation 751

November 1980

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COOLING TENDENCY IN THE SURFACE WATER OF THE NORTH ATLANTIC OCEAN

German Meteorological Service

UNITED STATES ARMY
CORPS OF ENGINEERS
COLD REGIONS RESEARCH AND ENGINEERING LABORATORY
HANOVER, NEW HAMPSHIRE, U.S.A.

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Unclassified
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER Draft Translation 751	2. GOVT ACCESSION NO. AD-A094	3. RECIPIENT'S CATALOG NUMBER 636
4. TITLE (and Subtitle) COOLING TENDENCY IN THE SURFACE WATER OF THE NORTH ATLANTIC OCEAN,		5. TYPE OF REPORT & PERIOD COVERED Translation 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) German Meteorological Service		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS -TL-754		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Cold Regions Research and Engineering Laboratory Hanover, New Hampshire 03755		12. REPORT DATE November 1980 13. NUMBER OF PAGES 4
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Translation by T.E.X. Associates, Philadelphia, Pa.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

North Atlantic Ocean
Surface waters
Water temperature

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Results from the water temperature measurements from 9 "meteorological ship" positions making up the North Atlantic Ocean Weather Stations (all together about 380,000 observations) over the last 15 years have revealed that the surface temperature of the outer tropical North Atlantic has dropped continuously since the five-year period (1951-55). This phenomenon is considered in detail.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

UMSCHAU 1966, No. 23, p. 777.

COOLING TENDENCY IN THE SURFACE WATER OF THE NORTH ATLANTIC OCEAN

by

German Meteorological Service
Marine Meteorological Office, Hamburg

The results from the water temperature measurements from 9 "meteorological ship" positions making up the North Atlantic Ocean Weather Stations (abbreviated: OWS) taken over the last 15 years have been compiled, thus revealing - as a portion of all together about 380,000 observations - that the surface temperature of the outer tropical North Atlantic since the five-year period, 1951 - 1955, has dropped continuously (Figure 1). At the beginning of the present decade a slight recurrence did appear but this made up only 0.02°, whereas the previous drop loses an overall 0.34°.

Of course, in the development of the ocean surface temperature considerable regional variations exist. Figure 2 shows the regional distribution of the variations in water temperature. Only the European North Sea has become warmer and, above all, the Irminger Sea between Iceland and South Greenland. The greatest amount of cooling occured in the waters of station D "Gulf Stream", off southern Newfoundland. However, in the western portion of the ocean the entire area between 35° and 55° North appears to have become more than 0.5° cooler.

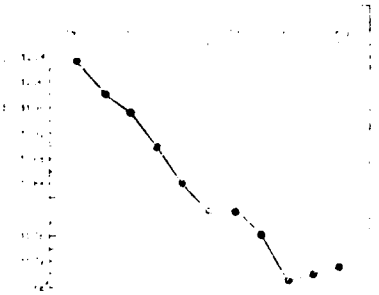


Figure 1: Year to year progressive five year average of the ocean surface temperatures for the 9 North Atlantic Weather Stations collectively. The five year period is represented by the middle year (e.g. 1953 = 1951-55).

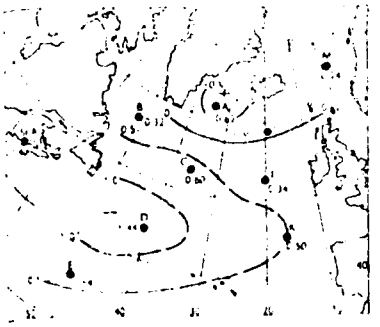


Figure 2: Variation in the ocean surface temperature from the 1951-55 five year period to the 1961-65 five year period.

A test at St. Andrews (St. A.) of the Canadian coastal waters shows that the coastal waters here were cooler by about the same amount (1.4°) as the ocean surface at OWS D, more than 1,000 nautical miles further east. The cooling in the abovementioned amount extends southward over the entire coast of the USA.

Therefore, it is necessary to consider the phenomenon in much greater detail. Since the 1949-53 five year period in St. Andrews was the warmest

since the measuring started in 1921 and - according to the air temperature series reports back to 1874 from Halifax, New Scottland - the warmest five year period in at least 80 years, the recent cooling trend appears to be interrupting the "centennial warming" in the North Atlantic.

The trend curves from OWS D (Figure 3) and OWS A (figure 4) demonstrate the two extremes of development. The sharpest temperature drop and the most marked warming. These point to a type of vacillation action between the southwestern and the northwestern North Atlantic. This in fact was very pronounced in the 1951-60 decade.

These opposing regional developments were indeed connected to the formation of the atmospheric circulation over the North Atlantic. It begins an extension - climatically - of the Iceland depression to the south and the cooling results in the area of intense cyclic activity (intense westerly winds), while the warming boundary in the marine area occurs with increased formation of southeasterly winds.

The character of the vacillation of the variations in the water temperature is like that of a stationary vibration. However, it appears also to be an anomolous shift in the cycle. Namely, the dates of the temperature maximums according to the trend curves (5-year, overlapping average) of the individual stations, i.e., of the onset of cooling, on a chart, thus results in the illustration represented by Figure 5. In it the year number represents the middle year of the warmest five year period (e.g., 1953 = 1951-55); the value in the parentheses stands for a decade of almost the same temperature. Accordingly, the cooling has started in the west of the ocean and its beginning is delayed still further toward the east to the northeast.

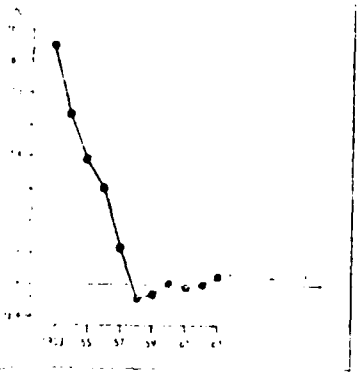


Figure 3: Year to year progressive five year mean of the ocean surface temperature for OWS D (44° N, 41° W). The five year periods are designated by their middle year (1953 = 1951-55).

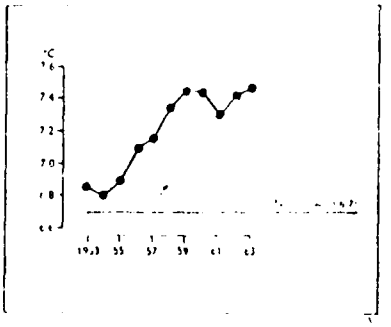


Figure 4: Year to year progressive five year mean of the ocean surface temperature for OWS A (62° N, 33° W). The five year periods are designated by their middle year (1953 = 1951-55).

This "cold wave" lasts at the individual stations - always established according to the overlapping five year average - on an average of 5 years (4 to 7) if a constant or increased temperature is regarded as the point in the curve. On the other hand, a new sharp cooling is evident in the west of the ocean at St. Andrews and OWS E in the 1961-65 five year period. Whether a large size oceanic "cold wave" recurs here, remains to be seen. In any case one may wonder thereupon whether in the initiated cooling trend of the North Atlantic surface waters (in stages) is advancing or not. Since Europe

is ventilated here from the west sea, a "circular cooling" of the North Atlantic Ocean would not persist without affecting the climatic conditions of the continent.

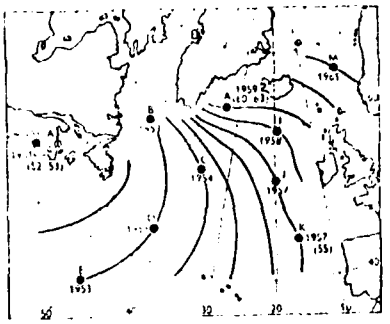
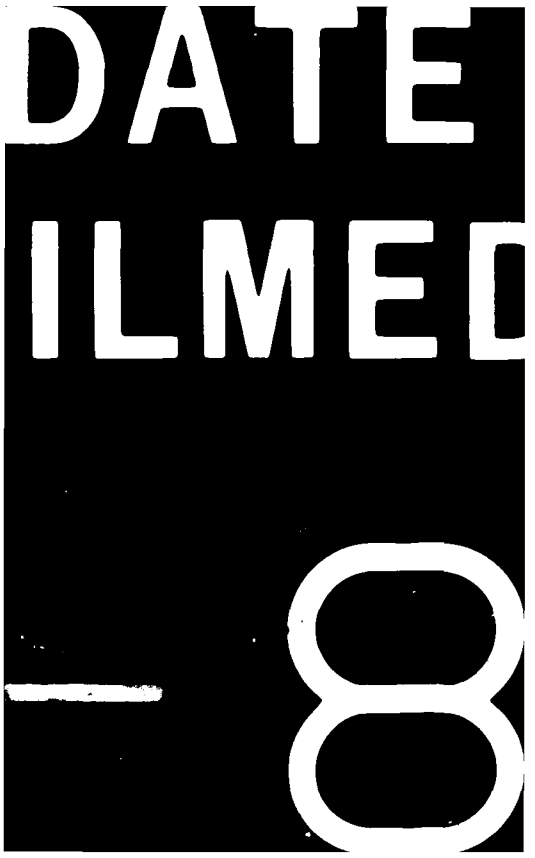


Figure 5: The year (= middle year of five year period) of maximum water temperature represents the onset of cooling - in the corresponding temperature pattern.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